

ART. II.—*The Diurnal and Annual Fluctuations of  
Temperature in the Interior of a large Tree.*

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In the autumn of 1926 it became necessary for me to find out the temperature of the earth in basements of stone, concrete, asphaltum, wood, and the like.

It occurred to me as to whether the trunk of a living tree has a temperature different from that of the surrounding air. Is the temperature of the heart wood different from that of the half-formed surface timber where growth and respiration are active? Does the translocation of food-materials produce heat? Is this heat (if any is found) neutralised by the ascending soil water?

The changes in the internal temperature of an inanimate object always lag behind those of the air outside, but if one continues recording the daily rise and fall long enough—for twelve months—the temperature of a column of iron or stone will average that of its surrounding air.

The choice of a tree fell on a specimen of *Pinus canariensis* in my garden at "Lalbert," Armadale, Victoria, which grew on a lawn amidst other trees, but whose trunk was surrounded by a dense hedge of *Coprosma* 6 ft. high and 3 ft. thick, which left inside a space 3 ft. wide where one could walk. The shade of the other trees, the branches above, and this hedge, constituted an effective screen between the sun and the trunk; therefore the sun's rays could not shine directly on to the trunk at any time, and only air of shade temperature could ever reach the trunk, conditions which one usually finds in a forest or wood. The girth of the trunk was 12 feet 6 inches at three feet from the ground on 10/7/26, and a year later had increased by an inch. The old dead corrugated bark is about three inches thick. The spread of the branches above is about 70 feet, and its height is 50 feet.

On 10th July, 1926, I took an auger 5/8 in. diameter and 2 ft. long, and having cut a circular cavity in the dead bark 3 in. diameter just down to the living wood, bored a hole 23 in. long to the centre of the trunk, parallel to the earth, from north to south, at a height of 3 ft. from the soil; also another similar hole at a tangent to the circumference of the living sap wood, so that the thermometer would be totally enclosed, and so that its bulb would be some 4 in. inside from the surface of the dead corky bark, and about 1 in. into the living outside ring. This hole ended 3 in. from the beginning of the core hole, and was at the same level, and was bored from the S.E. to the N.W.

Now when one bores a hole into a living tree, heat is engendered by the act; also the cells of wood around the hole begin to flow with sap, consequently the temperature of the first few days recorded by a thermometer is not normal, until the effects of the friction and injury have faded away.

The holes being prepared, thermometers (fitted with rubber corks) which recorded exactly similar temperatures as did my maximum and minimum thermometer at  $53^{\circ}\text{F.}$ , at  $60^{\circ}$  and at  $72^{\circ}$ , were inserted—one in each hole. The thermometer for the core hole was wired to a skewer of hard wood, whose outer end protruded 1 in. from the rubber cork, in order to facilitate removal for observation; both corks exactly fitted the holes, and by cutting a niche in the corks one could always pull them out so that the column of mercury was uppermost, and put them back the same way. This enables one to see the position of the column instantly on withdrawal, and to read the temperature accurately, even if the column moves. The whole operation of withdrawal, reading and replacement takes only four to five seconds, after one becomes accustomed to it. The maximum and minimum thermometer was hung 1 in. away from the bark at the spot where the bulb of the bark thermometer was, and over the hole of the core thermometer. It is useless to take the temperature of a tree trunk in one part of a forest unless one records the temperature of the air at the same spot.

The temperatures were taken at sundown, but in the warm weather the minimum was read in the morning, and the maximum in the evening of the same day. In the winter the temperatures in my garden were very similar to those issued daily in the *Argus*, but in the summer the temperatures in the garden were much lower than those of the bureau. Having proceeded thus for about one month, and shown the idea to Professor Ewart, he encouraged me to continue for at least twelve months. With few exceptions, due to absence, the recording of temperatures proceeded daily for twelve months, and to facilitate the summarising of the results they are presented in graph form. From perusal of the results it will be seen that:—

- (a) The mean annual temperature of the heart wood was  $1^{\circ}\text{F.}$  lower than that of the air.
- (b) The mean annual temperature of the alburnum was  $1.1^{\circ}\text{F.}$  higher than that of the air.
- (c) The mean annual temperature of the duramen and alburnum combined was the same as the mean temperature of the air.

Further observations showed that although the trunk was shaded, the average temperature of the alburnum on the north side was one degree higher than that on the south side, and hence the average temperature of the centre of the tree was not more than half a degree lower than the mean of the two sides. This difference I suggest is due to the fact that the average temperature of

the air on the south side of this tree was  $1^{\circ}$  lower than that on the north side. The flow of heated air in Australia is from the north and the flow of cold air is from the south, though it has also been suggested that the ascending water stream cuts off a small fraction of the external heat of the air from the duramen, which otherwise

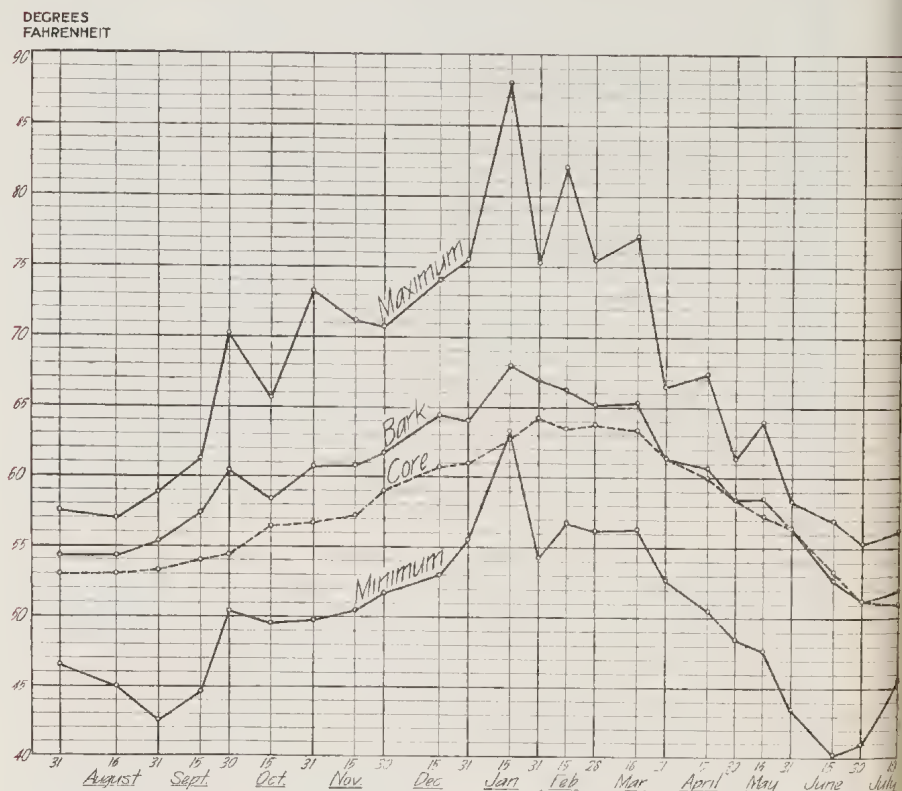


FIG. 1.—Temperature of Air and of a *Pinus canariensis* throughout year 1916-17.

Average mean temperature of air for year =  $58.7^{\circ}$  Fahr.

Average mean temperature of bark and core =  $58.7^{\circ}$  Fahr.

Trunk 12'-6" girth at 3' from ground, completely shaded by dense hedge of *Coprosma*.

behaves in regard to external temperature variations as an inert mass having no appreciable production of heat of its own.

During the whole period of observation there did not occur at any time any positive indication of any alteration in temperature due to pollination, or the sudden bursting into growth of the needle buds or the growth of branches, nor did sudden drenching with rain produce the fall of temperature one would expect. On March 18th, 1927, the bark on the trunk became soaked with rain, and the temperatures rose  $0.5^{\circ}$ . This happened again on April 12th, 1927. I suggest this is due to the rushing of the water by

capillarity into the vesicular tissue of dry, dead bark, developing heat by friction and chemical action. The rain was colder than the bark.

As a rule the difference between the maximum and minimum temperatures did not result in much variation in the heat of the alburnum at the time of occurrence in this tree. In June, 1927, owing to a succession of frosts followed by warm afternoons, I took the opportunity of recording the temperature of the alburnum frequently, and from this it will be seen that there was only a difference of  $0.5^{\circ}\text{F}$ . between the temperature at about 6-8 a.m., when the ground was white with frost, and the temperature about 4-6 p.m., when by contrast the air was warm and the afternoon delightfully sunny. I suggest this is due in this tree to the fact that the alburnum is insulated from the air on the outside by a thick layer of dead bark, which is a bad conductor of heat. The slowness of the change in temperature in the core of this tree trunk is illustrated by noting the fact that by the 12th June, 1927, the average daily mean temperature of the air had fallen 7 degrees owing to frost, whereas two feet inside the tree it required four days to reduce the temperature by  $2^{\circ}\text{F}$ .

At the same time I became possessed of the idea that the temperature of this tree was more subject to change from atmospheric causes in the first half of this year than it was in the last half of last year. I suggest it is due to the fact that the tree is drained of water due to its spring growth, and that consequently its specific heat is lower than in the spring.

I have noticed that dead, dry timber seasoned, fluctuates more than timber of the same dimensions does in a living tree, and consider this is due to its low specific heat, owing to the absence of "free" water.<sup>1</sup>

On one occasion the temperature of the core fell faster than that of the alburnum. This was on and about the 21st to the 26th May, 1927, when the temperature of the core was reduced by the falling temperature of the air, would have been the temperature of the alburnum, but for the fact that again rain drenched the bark, and either its condensation in the dead bark or the fact that it was warmer than the air, caused a rise in temperature, which warmed the alburnum. As soon as the rain stopped the bark dried and the temperature of the outside of the tree suffered a quick fall, and on the 26th became lower than the core.

While taking these temperatures daily, I began to take the temperature of many other varieties of trees and their parts, and noticed many curious happenings which may be of interest. This has resulted in the conviction in my mind—

- (1) That all dicotyledonous trees average (over long periods) almost the same temperature as the air of the forest or

<sup>1</sup> It has been suggested by Professor Ewart, however, that it is due to the effect of the transpiration current.

locality where they live, although small trees have a greater daily variation of temperature than large trees, as they have more bark surface per unit of mass than the latter.

- (2) That trees with smooth bark have a greater daily variation in temperature than those with thick, corky, or stringy bark.
- (3) That the parts of trees upon which the sun shines have a greater variation than those in permanent shade, and that the thinner branches have a greater daily variation than the trunk.
- (4) That the twigs from which the leaves grow vary in temperature hourly.
- (5) That the temperature of the smooth barked part of a branch on eucalypts varies more than that of the part which—although the same thickness—is nearer the trunk, and which is covered with stringy or hairy or corrugated bark.
- (6) That the average temperature of any part of the trunk of a large tree shows no evidence of any material average difference in temperature from that of the atmosphere. There is always the "lag," but the temperature average is practically the same over long periods.
- (7) That all leaves in my garden, whether of Australian or other origin, which admit of the bulb of a thermometer being wrapped up in them, are of the same temperature as that of the air with which they are surrounded.
- (8) That the ascending water current can only influence the temperature of the trunk in the alburnum or water-conducting wood.

In conclusion I wish to thank Dr. Ewart for his assistance and for codifying my results; also Messrs. Lang and Mitchell, consulting engineers, for the preparation of the graph.

Temperature of Core and living sap cells of *Pinus Canariensis*.

NOTE—All tree temperatures were taken at sundown.

1926	TREE TEMPERATURES				AIR SHADE TEMPERATURES		Remarks.
	Core	Bark	Max.	Min.			
July	10 - 54 °F	- 54 °	- 58 °	- 43 °	-	-	Auger heat
	11 - 53	- 54	- 61	- 50	-	-	
	12 - 53	- 54	- 61	- 49	-	-	
	13 - 53	- 54	- 58	- 44	-	-	
	14 - 53	- 54	- 58	- 48	-	-	
	15 - 54	- 54	- 53	- 45	-	-	
	16 - 53	- 54	- 54	- 42	-	-	
	17 - 53	- 54	- 55	- 45	-	-	
	18 - 53	- 54	- 56	- 43	-	-	
	19 - 53	- 54	- 55	- 40	-	-	
	20 - 53	- 54	- 59	- 48	-	-	
	22 - 53	- 54.5	- 69	- 56	-	-	
	23 - 53	- 54.5	- 57	- 47	-	-	
	24 - 53	- 54	- 53	- 44	-	-	Rain
	25 - 53	- 54	- 53	- 43	-	-	Rain
	26 - 53	- 54	- 56	- 47	-	-	
	27 - 53	- 54	- 59	- 48	-	-	
	28 - 53	- 54	- 58	- 50	-	-	
	29 - 53	- 54	- 59	- 49	-	-	
	30 - 53	- 54	- 57	- 48	-	-	
	31 - 53	- 54.5	- 60	- 50	-	-	
	Av. 21 days	53	- 54.1	- 57.5	- 46.6	-	Mean air temp° 52 °
August	1 - 53	- 54	- 55	- 45	-	-	
	2 - 53	- 54	- 59	- 42	-	-	
	3 - 53	- 54	- 53	- 46	-	-	
	4 - 53	- 54	- 55	- 40	-	-	Rain
	5 - 53	- 54	- 56	- 42	-	-	
	6 - 53	- 54	- 55	- 44	-	-	
	7 - 53	- 54	- 55	- 45	-	-	
	8 - 53	- 54	- 56	- 44	-	-	
	9 - 53	- 54	- 54	- 44	-	-	
	10 - 53	- 54	- 65	- 53	-	-	
	11 - 53	- 54	- 60	- 52	-	-	
	12 - 53	- 54	- 58	- 52	-	-	
	13 - 53	- 54	- 56	- 41	-	-	
	14 - 53	- 54.5	- 59	- 41	-	-	
	15 - 53	- 54.5	- 59	- 48	-	-	
	16 - 53	- 54.5	- 57	- 41	-	-	
	Av. 16 days	53	- 54.1	- 57	- 45	-	Mean=51 °
	17 - 53	- 54.5	- 59	- 48	-	-	Buds loosening
	18 - 53	- 54.5	- 66	- 44	-	-	
	19 - 53	- 55	- 65	- 53	-	-	
	20 - 53	- 55	- 53	- 42	-	-	
	21 - 53	- 55	- 52	- 36	-	-	Pollen cones forming
	22 - 53	- 55	- 57	- 32	-	-	Frosty
	23 - 53	- 55	- 61	- 34	-	-	
	24 - 53.5	- 55	- 62	- 42	-	-	
	25 - 53.5	- 55	- 55	- 53	-	-	
	26 - 53.5	- 55	- 54	- 40	-	-	
	27 - 53.5	- 55	- 53	- 41	-	-	
	28 - 54	- 55.5	- 65	- 34	-	-	
	29 - 54	- 56	- 64	- 49	-	-	
	30 - 54	- 56	- 57	- 47	-	-	
	31 - 54	- 56	- 58	- 42	-	-	
	Av. 15 days	53.4	- 55.2	- 58.7	- 42.5	-	Mean=50.6 °

1926		Core		Bark		Max.		Min.		Remarks.
September	1	- 54	-	56	-	63	-	44	-	
	2	- 54	-	56	-	63	-	42	-	
	3	- 54	-	56.5	-	61	-	50	-	Buds bursting freely
	4	- 54	-	56.5	-	59	-	42	-	
	5	- 54	-	57	-	56	-	45	-	
	6	- 54	-	57	-	57	-	39	-	
	7	- 54	-	57	-	60	-	45	-	
	8	- 54	-	57	-	67	-	37	-	
	9	- 54	-	57	-	72	-	47	-	
	10	- 54	-	58	-	59	-	50	-	
	11	- 54	-	58	-	59	-	43	-	Pollen cones ripe
	12	- 54	-	58	-	63	-	50	-	Fruit cones appear
	13	- 54	-	58.5	-	64	-	52	-	
	14	- 54	-	59	-	55	-	45	-	
	15	- 54	-	59	-	61	-	40	-	
Av. 15 days	54	-	57.3	-	61.2	-	44.7	-	Mean=52.9°	
	16	- 54	-	59	-	70	-	40	-	
	17	- 54	-	59.5	-	67	-	41	-	
	18	- 54	-	60	-	70	-	43	-	
	19	- 54	-	61	-	78	-	45	-	
	20	- 54	-	61	-	76	-	53	-	
	21	- 54	-	61	-	73	-	56	-	
	22	- 54	-	62	-	85	-	57	-	Hot wind
	23	- 54	-	63.5	-	81	-	63	-	
	24	- 54	-	62.5	-	57	-	52	-	
	25	- 54.5	-	61	-	70	-	52	-	Pollen cones empty
	26	- 55	-	60	-	74	-	54	-	
	27	- 55.5	-	59.5	-	73	-	55	-	
	28	- 56	-	58.5	-	58	-	51	-	Rain
	29	- 56.5	-	59.5	-	60	-	51	-	
	30	- 56.5	-	59	-	64	-	42	-	
Av. 15 days	54.6	-	60.5	-	70.4	-	50.3	-	Mean=60.3°	
October	1	- 57	-	59	-	74	-	44	-	
	2	- 57	-	60	-	74	-	54	-	
	3	- 57	-	61	-	68	-	58	-	Re-bored hole
	4	- 57	-	59	-	67	-	44	-	centre
	5	- 56.5	-	58.5	-	61	-	54	-	Very wet and
	6	- 57	-	58	-	62	-	50	-	windy
	7	- 56.5	-	57	-	59	-	49	-	Wet and
	8	- 56.5	-	56	-	58	-	48	-	windy
	9	- 57	-	57	-	60	-	49	-	
	10	- 57	-	58	-	70	-	50	-	
	11	- 57	-	59	-	68	-	48	-	Fine, S. W. wind
	12	- 57	-	57	-	60	-	45	-	Gales, rain
	13	- 57	-	57	-	65	-	52	-	
	14	- 56	-	57	-	75	-	48	-	Rain
Av. 14 days	56.8	-	58.1	-	65.8	-	49.5	-	Mean=57.6°	
	16	- 56	-	60	-	80	-	47	-	
	17	- 56	-	58.5	-	77	-	50	-	Hot
	18	- 56	-	60	-	75	-	48	-	"
	19	- 56	-	60.5	-	74	-	52	-	"
	20	- 56	-	59	-	70	-	45	-	"
	21	- 56.5	-	62	-	77	-	52	-	"
	22	- 56.5	-	62	-	76	-	55	-	"
	23	- 56.5	-	61	-	70	-	55	-	"

*Fluctuation of Temperature in a large tree.*

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1926			Core		Bark		Max.		Min.		Remarks.
October	24	-	56.5	-	60.5	-	70	-	48	-	"
	25	-		-		-		-		-	"
	26	-	57.5	-	59.5	-	66	-	48	-	Cool
	27	-	57.5	-	62.5	-	79	-	50	-	Hot
	28	-	57.5	-	63	-	82	-	49	-	
	29	-	57.5	-	62.5	-	75	-	59	-	Gales N.W.
	30	-	57.5	-	62	-	63	-	49	-	Bleak (rain)
	31	-	58	-	60	-	68	-	40	-	" "
Av. 15 days			56.8	-	60.9	-	73.4	-	49.8	-	Mean=61.6°
November	1	-	57.5	-	59	-	68	-	55	-	
	2	-	57.5	-	59.5	-	68	-	47.5	-	
	3	-	57.5	-	58.5	-	61	-	50	-	Cold, Gale
	4	-	57.5	-	57.5	-	58	-	45	-	" " hail
	5	-	57	-	56.5	-	57	-	48	-	" " "
	6	-	57	-	56.5	-	66	-	45	-	" " "
	7	-	57	-	60	-	80	-	47	-	
	8	-	57	-	65	-	93	-	55	-	N.W. gale
	9	-	57	-	65.5	-	89	-	55	-	6 p.m.
	10	-	57	-	63	-	70	-	51	-	
	11	-	57	-	60	-	66	-	47	-	
	12	-	57.5	-	65	-	86	-	46	-	Very dry
	13	-	57.5	-	63	-	74	-	54	-	
	14	-	57.5	-	63	-	68	-	54	-	
	15	-	58	-	62	-	68	-	55	-	
Av. 15 days			57.3	-	60.9	-	71.4	-	50.3	-	Mean=60.8°
	16	-	58	-	62	-	77	-	49	-	
	17	-	58	-	61	-	65	-	45	-	Gales rainy W.
	18	-	58.5	-	59	-	63	-	48	-	Showers passed
	19	-	59	-	61	-	79	-	47	-	Dry conditions
	20	-	59	-	62.5	-	84	-	52	-	
	21	-	59	-	64	-	76	-	59	-	
	22	-	59	-	63	-	69	-	55	-	
	23	-	59	-	61	-	63	-	54	-	Cold wind S.W
	24	-	58.5	-	59.5	-	62	-	51	-	Needles ex-
	25	-	58.5	-	59.5	-	63	-	53	-	panding
	26	-	59	-	60	-	65	-	47	-	
	27	-	59.5	-		-		-		-	
	28	-	60	-	67	-	97	-	52	-	Hot, very dry
	29	-	60	-	64	-	66	-	60	-	
	30	-	60	-	61	-	63	-	53	-	
Av. 15 days			59	-	61.7	-	70.8	-	51.8	-	Mean=61.3
December	1	-	60	-	62	-	70	-	54	-	
	2	-	60	-	62	-	74	-	48	-	
	3	-	60	-	70	-	94	-	53	-	
	4	-	60.5	-	67	-	78	-	62	-	
	5	-	61	-	65	-	70	-	60	-	15 points rain
	6	-	60.5	-	63	-	67	-	51	-	W. Gale
	7	-	61	-	63	-	74	-	47	-	
	8	-	61	-	64	-	78	-	57	-	
	9	-	61.5	-	66.5	-	91	-	56	-	Leaves small
	10	-	61	-	68	-	64	-	58	-	and scanty,
	11	-	61.5	-	64	-	69	-	48	-	too dry
	12	-	61	-	62	-	64	-	52	-	Fine and cool
	13	-	61	-	61.5	-	61	-	51	-	
	14	-		-		-		-		-	
	15	-	61	-	66	-	80	-	45	-	
Av. 14 days			60.8	-	64.5	-	73.8	-	53	-	Mean=63.4°

1926		Core	Bark	Max.	Min.	Remarks.
	16	- 61	- 65	- 81	- 62	- 16 points rain
	17	- 61	- 63	- 75	- 57	- Rain
	18	- 61	- 62	- 63	- 56	-
	19	- 61	- 61	- 63	- 53	-
	20	- 61	- 63	- 72	- 52	-
	21	- 61	- 64	- 85	- 54	- } 40 points
	22	- 61	- 63	- 64	- 55	- }
	23	- 60.5	- 62	- 67	- 55	-
	24	- 60.5	- 65	- 87	- 45	-
	25	- 61	- 66	- 92	- 60	- Hot
	26	- 61	- 68	- 82	- 62	-
	27	- 61	- 66	- 71	- 59	-
	28	- 61	- 64	- 75	- 55	-
	29	- 61.5	- 64	- 79	- 56	- No dew
	30	- 61.5	- 64.5	- 78	- 53	-
	31	-	-	-	-	-
	Av. 15 days	61	- 64	- 75.6	- 55.6	- Mean = 65.6°
1927		Core	Bark	Max.	Min.	Remarks.
January	1-5	{ -	-	- 85	- 49	- For period of 6
		{ absent	-	-	-	- days Rain, drizzle
	6	- 62	- 64.5	-	-	-
	7	- 62	- 64	- 68	- 60	-
	8	- 62	- 63	- 72	- 57	-
	9	- 62	- 65	- 90	- 56	-
	10	- 62.5	- 68	- 94	- 67	- Hot and dry
	11	- 63	- 71	- 96	- 70	-
	12	- 63	- 72	- 92	- 67	-
	13	- 63.5	- 71	- 90	- 61	- Old needles
	14	- 64	- 74	- 102	- 69	- dropping freely
	Av. 9 days	62.7	- 68	- 88	- 63.4	- Mean = 75.7°
	15	- 64.5	- 73.5	- 80	- 63	- Cool change
	16	-	-	- 70	- 57	-
	17	- 65	- 73	- 79	- 55	- 25 points rain
	18	- 65	- 69	- 75	- 59	-
	19	- 65	- 66	- 68	- 51	-
	20	- 65	- 72	- 88	- 50	-
	21	- 65	- 62	- 83	- 60	-
	22	- 64.5	- 66	- 80	- 50	-
	23	-	-	-	-	-
	24	- 64	- 67	- 83	- 60	-
	25	- 63.5	- 66	- 77	- 55	-
	26	- 63.5	- 65	- 74	- 40	-
	27	- 63.5	- 64	- 64	- 57	-
	28	- 63.5	- 64	- 67	- 53	-
	29	- 63.5	- 63	- 67	- 49	-
	30	-	-	-	-	-
	31	-	-	-	-	-
	Av. 13 days	64.3	- 67	- 75.4	- 54.2	- Mean = 64.8°
February	1	- 64	- 66	- 82	- 52	-
	2	- 64	- 69	- 89	- 61	-
	3	- 64	- 66	- 82	- 54	- 60 mile gale
	4	- 64	- 66	- 78	- 60	-
	5	- 63.5	- 63	- 70	- 55	-
	6	- 63	- 64.5	- 74	- 55	-
	7	- 63	- 65	- 78	- 57	- Premature Au-
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*Fluctuation of Temperature in a large tree.*

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1927		Core	Bark	Max.	Min.	Remarks.
	8	- 63	- 64	- 67	- 53	- No moisture or
	9	- 63	- 65	- 82	- 48	- dew
	10	- 63	- 69	- 93	- 56	- No sap flow,
	11	- 63.5	- 70	- 98	- 61	- heat now felt
	12	- 63.5	- 69	- 91	- 73	- at once thro'
	13	-	-	-	-	- the bark, no
	14	- 63.5	- 68	- 98	- 55	- evaporation
	15	- 64	- 66	- 68	- 57	- to resist heat
	Av. 14 days	63.5	- 66.4	- 82.1	- 56.9	- Mean = 69.5°
	16	- 63.5	- 65.5	- 70	- 60	-
	17	- 64	- 66	- 77	- 56	-
	18	- 64	- 66.5	- 80	- 62	-
	19	- 63.5	- 64	- 75	- 57	-
	20	-	-	-	-	-
	21	- 63.5	- 66	- 77	- 55	-
	22	- 64	- 67	- 80	- 53	-
	23	- 64	- 68	- 82	- 61	-
	24	- 64	- 65	- 77	- 54	- A little rain
	25	- 64	- 64	- 68	- 52	-
	26	- 63.5	- 63	- 65	- 55	-
	27	- 63.5	- 64	- 74	- 56	-
	28	- 64	- 64	- 82	- 55	-
	Av. 12 days	63.7	- 65.2	- 75.5	- 56.3	- Mean = 65.9°
March	1	- 64	- 68	- 97	- 59	- Very hot
	2	- 64	- 70	- 93	- 71	-
	3	- 63.5	- 69	- 83	- 80	- Sudden cold
	4	- 63.5	- 66	- 67	- 49	- change at
	5	- 63.5	- 64	- 65	- 52	- noon
	6	- 63.5	- 62	- 58	- 51	-
	7	- 63.5	- 63	- 76	- 48	-
	8	- 63.5	- 63.5	- 75	- 50	-
	9	- 63.5	- 65	- 77	- 48	-
	10	- 63.5	- 66	- 84	- 50	-
	11	- 63.5	- 68	- 92	- 63	-
	12	- 63.5	- 66	- 84	- 58	- Lawns nearly
	13	- 63.5	- 65	- 80	- 51	- dead, 160
	14	- 63.5	- 64	- 69	- 58	- points since
	15	- 63	- 64	- 67	- 58	- January 1
	16	- 63	- 63	- 68	- 57	-
	Av. 16 days	63.5	- 65.4	- 77.2	- 56.4	- Mean = 66.8°
	17	- 63	- 63.5	- 72	- 57	-
	18	- 63	- 64	- 62	- 56	- Rain at last
	19	- 63	- 63	- 63	- 54	- Trunk of tree
						- soaking, yet
						- temp. of outer
	20	- 63	- 62	- 63	- 52	- rings rose 0.5°
	21	- 62.5	- 61	- 65	- 56	- F. 70 pts. rain
	22	- 62	- 60.5	- 56	- 51	- Drizzle
	23	- 62	- 60	- 57	- 54	-
	24	- 61.5	- 60	- 57	- 54	-
	25	- 61.5	- 60.5	- 69	- 57	-
	26	- 61	- 60.5	- 65	- 52	-
	27	- 60.5	- 60	- 60	- 54	-
	28	- 60	- 60	- 70	- 53	-
	29	- 60	- 61	- 77	- 41	-
	30	- 60	- 62	- 83	- 47	-
	31	- 60	- 61.5	- 77	- 55	-
	Av. 15 days	61.5	- 61.3	- 66.4	- 52.8	- Mean = 59.6°

1927		Core	Bark	Max.	Min.	Remarks.
April	1	- 59.5	- 61.5	- 69	- 57	-
	2	- 59.5	- 60.5	- 65	- 56	-
	3	-	-	} 85	- 49	Max. and min. for two days
	4	-	-			
	5	- 60	- 63	- 75	- 52	-
	6	- 60	- 62	- 62	- 46	-
	7	- 60	- 62	- 65	- 53	-
	8	- 60	- 61	- 65	- 55	-
	9	- 60	- 60	- 66	- 44	-
	10	- 60	- 60	- 64	- 51	-
	11	- 60	- 59	- 61	- 44	-
	12	- 60	- 62	- 69	- 49	- A little rain
	13	- 60	- 60	- 65	- 53	-
	14	- 60	- 59.5	- 64	- 51	-
	15	- 60	- 59.5	-	-	-
Av. 13 days		60	- 60.8	- 67.3	- 50.7	- Mean = 59.0°
	16	- 59.5	- 59	-	-	-
	17	- 59.5	- 59	} 68	- 43	Max. and min. for two days
	18	- 59.5	- 59			
	19	- 59	- 59.5	- 63	- 50	-
	20	- 59	- 59	- 60	- 45	- Hole in bark
	21	- 59	- 58	- 58	- 51	- closing up, re-
	22	- 59	- 57	- 59	- 47	- bored
	23	- 58.5	- 57.5	- 61	- 52	-
	24	- 58.5	- 58	- 62	- 54	-
	25	- 58	- 58	- 60	- 53	-
	26	- 58	- 57	- 58	- 50	-
	27	- 58	- 57.5	- 63	- 48	-
	28	- 58	- 60	- 68	- 43	-
	29	- 58	- 60.5	- 70	- 47	- Many trees
	30	- 58	- 59	- 63	- 48	- dying, leaves falling
Av. 15 days		58.7	- 58.5	- 62.5	- 48.5	- Mean = 55.5°
May	1	- 58	- 58	- 57	- 42	-
	2	- 58	- 59.5	- 63	- 44	-
	3	- 58	- 59	- 61	- 46	- Nice rain 30
						points. Copi-
						ous condensa-
						tion of mois-
						ture on ther-
						mometer in
	4	- 58	- 58	- 58	- 47	- core lately.
	5	- 57.5	- 57.5	- 62	- 46	- This has not
	6	- 57.5	- 57	- 63	- 43	- occurred be-
	7	- 57	- 58	- 67	- 41	- fore. None on
	8	- 57	- 60	- 73	- 50	- the thermom-
	9	- 57	- 59.5	- 73	- 48	- eter in bark
	10	- 57	- 60.5	- 67	- 58	- Rain
	11	- 57	- 58.5	- 60	- 48	- Rain, 50 points.
	12	- 57	- 58.5	- 57	- 45	- Dull
	13	- 57	- 58.5	- 62	- 48	-
	14	- 57	- 58.5	- 66	- 49	-
	15	- 57	- 59	- 67	- 54	-
	16	- 57	- 58.5	- 68	- 54	-
Av. 16 days		57.4	- 58.6	- 64	- 47.7	- Mean = 55.8°
	17	- 57	- 59	- 66	- 49	-
	18	- 57	- 57	- 58	- 44	-
	19	-	-	-	-	-
	20	-	-	-	-	-
	21	- 57	- 58	- 63	- 44	-

1927		Core		Bark		Max.		Min.		Remarks.
	22	-	57	-	58	-	64	-	46	- Rain, 25 points
	23	-	57	-	58	-	60	-	48	-
	24	-	57	-	57.5	-	59	-	46	- Rain
	25	-	56.5	-	57.5	-	58	-	47	- Fall of temp. in core not always preceded by fall of temp. in bark
	26	-	56.5	-	56	-	56	-	44	-
	27	-	56	-	56.5	-	55	-	46	-
	28	-	56	-	55	-	51	-	44	-
	29	-	55.5	-	54	-	56	-	41	- Rain
	30	-	55.5	-	53.5	-	56	-	34	- Fine, 26° on grass, frost
	31	-	55	-	53	-	58	-	34	- Fine, frost
	Av. 13 days		56.4	-	56.4	-	58.5	-	43.6	- Mean = 51.0°
June	1	-	54.5	-	53	-	57	-	33	- Fine, frost
	2	-	54	-	53	-	59	-	37	- " "
	3	-	54	-	53	-	59	-	33	- " "
	4	-	53.5	-	54	-	60	-	48	- Rain
	5	-	53.5	-	55	-	64	-	55	-
	6	-	53.5	-	54.5	-	58	-	45	-
	7	-	53.5	-	54	-	56	-	44	-
	8	-	53	-	54	-	57	-	47	-
	9	-	53	-	52.5	-	50	-	40	-
	10	-	53	-	51.5	-	51	-	43	- Drizzle & rain
	11	-	53	-	52	-	53	-	45	-
	12	-	53	-	51.5	-	56	-	33	- Frost, fine
	13	-	52.5	-	52	-	55	-	32	- " "
	14	-	52	-	51.5	-	58	-	33	-
	15	-	51.5	-	51.5	-	61	-	35	-
	Av. 15 days		53.1	-	52.8	-	57	-	40.2	- Mean = 48.6°
	16	-	51.5	-	51	-	53	-	33	-
	17	-	51	-	50.5	-	55	-	32	-
	18	-	51	-	51	-	57	-	46	-
	19	-	51.5	-	51.5	-	63	-	50	-
	20	-	51.25	-	52.5	-	60	-	48	-
	21	-	51.5	-	52	-	52	-	44	- Record number of frosts.
	22	-	51.5	-	52.5	-	56	-	46	-
	23	-	51.5	-	53	-	57	-	49	-
	24	-	51.5	-	53	-	57	-	46	-
	25	-	51.5	-	52.5	-	54	-	47	-
	26	-	51.5	-	51.5	-	54	-	42	- Fine
	27	-	51.5	-	51	-	53	-	37	- "
	28	-	51.5	-	48.5	-	47	-	31	- Fine, very cold fog at 8 a.m.
	29	-	51.5	-	49.5	-	55	-	32	- Fine, warmer
	30	-	51.5	-	50.5	-	57	-	32	-
	Av. 15 days		51.4	-	51.4	-	55.3	-	41	- Mean = 48.1°
July	1	-	51	-	52	-	57	-	47	- It took 4 days for the successive waves of cold to affect the core
	2	-	51	-	52	-	56	-	45	-
	3	-	51	-	52	-	57	-	48	-
	4	-	51	-	52	-	56	-	46	-
	5	-	51	-	52	-	57	-	49	- Rain all over
	6	-	51	-	53	-	59	-	50	- Vic. 50 to 100 points
	7	-	51	-	53	-	54	-	44	-
	8	-	51	-	52	-	53	-	41	-
	9	-	51	-	51.5	-	53	-	42	-
	10	-	51	-	51.5	-	58	-	44	-
	11	-	51	-	52	-	58	-	47	-
	Av. 11 days		51	-	52	-	56.2	-	45.7	- Mean = 50.9°

*Summary of Average Temperatures.*

		TREE		AIR		TREE	AIR
		Core	Bark	Max.	Min.	Mean	Mean
July	10-31	- 53	- 54.1	- 57.5	- 46.6	- 53.5	- 52
August	1-16	- 53	- 54.1	- 57	- 45	- 53.5	- 51
	17-31	- 53.4	- 55.2	- 58.7	- 42.5	- 54.3	- 50.6
Sept.	1-15	- 54	- 57.3	- 61.2	- 44.7	- 55.6	- 52.9
	16-30	- 54.6	- 60.5	- 70.4	- 50.3	- 57.5	- 60.3
October	1-15	- 56.8	- 58.1	- 65.8	- 49.5	- 57.4	- 57.6
	16-31	- 56.8	- 60.9	- 73.4	- 49.8	- 58.8	- 61.6
Nov.	1-15	- 57.3	- 60.9	- 71.4	- 50.3	- 59.1	- 60.8
	16-30	- 59	- 61.7	- 70.8	- 51.8	- 60.3	- 61.3
Dec.	1-15	- 60.8	- 64.5	- 73.8	- 53	- 62.6	- 63.4
	16-31	- 61	- 64	- 75.6	- 55.6	- 62.5	- 65.6
Jan.	1-14	- 62.7	- 68	- 88	- 63.4	- 65.3	- 75.7
	15-31	- 64.3	- 67	- 75.4	- 54.2	- 65.6	- 64.8
Feb.	1-15	- 63.5	- 66.4	- 82.1	- 56.9	- 64.9	- 69.5
	16-28	- 63.7	- 65.2	- 75.5	- 56.3	- 64.4	- 65.9
Mar.	1-16	- 63.5	- 65.4	- 77.2	- 56.4	- 64.4	- 66.8
	17-31	- 61.5	- 61.3	- 66.4	- 52.8	- 61.4	- 59.6
Apl.	1-15	- 60	- 60.8	- 67.3	- 50.7	- 60.4	- 59
	16-30	- 58.7	- 58.5	- 62.5	- 48.5	- 58.6	- 55.5
May	1-16	- 57.4	- 58.6	- 64	- 47.7	- 58	- 55.8
	17-31	- 56.4	- 56.4	- 58.5	- 43.6	- 56.4	- 51
June	1-15	- 53.1	- 52.8	- 57	- 40.2	- 52.9	- 48.6
	16-30	- 51.4	- 51.4	- 55.3	- 41	- 51.4	- 48.1
July	1-11	- 51	- 52	- 56.2	- 45.7	- 51.5	- 50.9
Average		57.7	59.8	67.5	49.8	58.7	58.7
		58.7		58.6		58.7	